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To: Rob Grandinetti and Dino Marshalonis, Environmental Protection Agency;
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From: Kevin Buckley, Seattle Public Utilities

Subject: Selection and Development of Representative Constituents of Concern (RCOC) for the Integrated Plan

The purpose of this memo is to document the development of the Representative Constituents of Concern (RCOC) that are being used in the Integrated Plan for the pollutant reduction estimates. The memo includes background on the requirements around development of the RCOCs from the Consent Decree and information about the modification of the RCOCs based upon input from the Expert Panel. The Expert Panel was engaged by Seattle Public Utilities to review the methodology being developed to evaluate the stormwater projects against the CSO project proposed to be deferred.

Background on Development of the RCOCs

The Integrated Planning option in the Consent Decree lists specific constituents and categories of constituents that must be used for the pollutant reduction estimates and the exposure assessment. The list from the Consent Decree is as follows:

- Conventional Pollutant Parameters
    - Biochemical oxygen demand
    - Fecal coliform bacteria
    - Total suspended solids
    - Oil and grease
    - pH
- Metals
- Nitrogen ammonia
- Phosphorous
- Pathogens
- Projected dissolved oxygen concentrations
- Toxic organic compounds

Where specifically called out (e.g. pH) the team used available data for the specific constituent. In the absence of a specific constituent (e.g. metals) the team identified surrogates based upon an evaluation of local stormwater and CSO monitoring data sources, knowledge about constituents of concern for receiving water bodies and input from the Expert Panel. The surrogates are as follows.

Table 1: Surrogate RCOCs		
Consent Decree Constituent	**Surrogate Chosen**	**Rationale**
Metals	Total and Dissolved Copper	Copper is commonly found in stormwater. Dissolved copper has been identified as a constituent of concern for salmonids
Metals	Total and Dissolved Zinc	Zinc is commonly found in stormwater. Runoff from commercial/ industrial areas can exceed freshwater criteria for dissolved zinc
Pathogens	Fecal Coliform	WAC 173-201 specifies fecal coliform as the indicator bacteria for all freshwater and most marine uses. CSO discharges are usually much higher than the state standard. Stormwater discharges are typically much lower than CSOs but often exceed the state standards.
Projected Dissolved Oxygen Concentrations	Projected Dissolved Oxygen.	The Expert Panel suggested utilizing BOD and other DO depletion to be considered for overall Do impacts.
Toxic Organic Compounds – Pesticides	Dichlobenil	Limited data is available on pesticides in stormwater and CSO discharges. Dichlobenil was analyzed and reported by Seattle and Tacoma as part of their 2007 NPDES Phase I monitoring data and was the pesticide with the highest number of detects.
Toxic Organic Compounds - PCBs	Total PCBs	PCBs are a key concern for the Duwamish Waterway
Toxic Organic Compounds - PBDEs	PBDEs	PBDEs have been widely used as flame retardants and have been identified as an emerging contaminant of concern.
Toxic Organic Compounds – Semi Volatile Organic Compounds	Bis(2-ethylhexyl)phthalate	Considered representative of SVOCs based on the available data from SPU and other sources.

The following data sources were used to help develop the RCOC surrogates and provide the data used for establishing the concentrations and loads used in the pollutant estimation method.

City of Seattle Stormwater Characterization Data collected for compliance with the 2007 NPDES Phase I Municipal Stormwater permit. Report available at: http://www.seattle.gov/util/documents/plans/stormwatermanagementplan/

SPU: Data collected for the 2011 NPDES Stormwater Monitoring Report ([H+], ammonia-N, bis(2-ethylhexyl)phthalate, BOD_5, D-Cu, T-Cu, dichlobenil, fecal coliform, TP, TSS, D-Zn, T-Zn)

Tacoma: Thea Foss and Wheeler-Osgood Waterways 2012 Source Control and Water Year 2012 Stormwater Monitoring Report ([H+], BOD5, D-Cu, T-Cu, dichlobenil, fecal coliform, PCB, TP, TSS, D-Zn, T-Zn)

ACWA: Oregon Association of Clean Water Agencies (ACWA) - ACWA stormwater database ([H+], ammonia-N, BOD5, D-Cu, T-Cu, fecal coliform, oil & grease, TP, TSS, D-Zn, T-Zn)

Spokane: Data collected for the following 2009 Washington Department of Ecology study: PBDE and Dioxin/Furans in Spokane Stormwater (PBDE).

NSQD : National Stormwater Quality Database – Version 3 ([H+], ammonia-N, BOD5, D-Cu, T-Cu, fecal coliform, oil & grease, TP, TSS, D-Zn, T-Zn)

King County: Data collected for the following 2013 study: PCB/PBDE Loading Estimates for the Greater Lake Washington Watershed (PCB, PBDE)

Ecology: Washington Department of Ecology's Lower Duwamish database (PCB).

King County Duwamish River Basin Combined Sewer Overflow Data Report for samples collected from September 2007 to January 2010. Report available here: http://your.kingcounty.gov/dnrp/library/wastewater/iw/CSO_DataReport/DuwRiverBasin_CSO_DataReport_Dec2011.pdf

City of Seattle Combined Sewer Overflow Supplemental Characterization Study, May 2010.

The following section of this memo provides a synopsis of the process SPU used to solicit input from the Expert Panel in order to develop and refine the list of RCOCs. The material presented below is excerpted from documents prepared for Expert Panel meetings and can be provided if needed.

April 29th Expert Panel Meeting

Table 2 below contains the initial list of Representative Constituents of Concern (RCOC) that was developed based upon the Consent Decree and review of the available stormwater and CSO water quality data. It was presented at the April 28th Expert Panel meeting and included in the Briefing Memo for the Expert Panel. The Consent Decree identifies a number of specific and representative conventional, metals, nutrient, pathogen and toxic organic compounds that the Integrated Plan must address. Based on this list of Consent Decree water quality requirements, the team developed the list of RCOCs to be evaluated and modeled. To develop

a list of RCOCs, the stormwater sampling data and receiving water data were reviewed to identify representative data sets to link pollutant concentrations (and their inherent variability) with land use categories. Stormwater data utilized to develop the RCOC list includes the City of Seattle and City of Tacoma NPDES Stormwater Characterization data collected for compliance with the 2007 NPDES Phase I Municipal Stormwater Permit, Oregon Association of Clean Water Agencies (OR ACWA) data sets and other suitable regional and/or national databases.

The following are the notes from the April 28th meeting with regards to the RCOCs:

- Bob Pitt cautioned against using five-day biological oxygen demand (BOD) to evaluate stormwater projects, as the analytical method can give distorted results. This is particularly a problem for measuring dissolved oxygen in sediments. The ultimate BOD (or also looking at the chemical oxygen demand, COD) is more accurate than the five-day measure.
    - Based on this comment, Geosyntec will further investigate how to characterize BOD when ultimate BOD was not measured but five-day BOD was included in the sampling events. There are a few alternatives to address this issue.
- Jean Zodrow observed that it seemed as though SPU did not have good data for some constituents, such as pesticides, and asked what the technical team would do in the absence of anything other than TSS to measure those constituents. Semi-volatile organic compounds (SVOCs) are another area where there may not be much data.
    - Rick Pleus of Intertox clarified that the issue with pesticides was not that SPU did not have data for pesticides, but that the technical team had not identified which pesticide it would evaluate and what data are available to consider. The technical team is currently evaluating the data available. For example, it appears that two weaknesses in data quality and quantity may be PBDEs and oil/grease. He also asked whether choosing certain surrogates, such as copper for metals, would cause the team to miss anything important.
    - Jean Zodrow suggested that PCBs could be a surrogate for PBDE, as those constituents may have similar behavior. For SVOCs, TSS could potentially be used. It is important to pick the right constituents to measure, since they get carried through. Rick Pleus said he understands the possible use of surrogates in the Exposure Assessment but would need to consider the data sets and constituents better to provide an opinion whether either of these is reliable.
    - Bob Pitt noted that some constituents, such as copper, could be present in many types of form (complex, ionic, coil, associated with sediment, etc.). The different forms of the constituent will behave differently, and that could affect toxicity and exposures.
    - Bob Pitt asked whether SPU would use water chemistry modeling to evaluate the behavior of different speciation of constituents. Rob Annear of Geosyntec said that the technical team would be relying on receiving water and stormwater sampling data.

Table 2: Constituents of Concern Identified in the Consent Decree	
Constituents of Concern identified in the Consent Decree	**Preliminary Potential water quality constituents to evaluate (and possible surrogates) – April 2013**
Biochemical oxygen demand	Biochemical oxygen demand
Fecal coliform bacteria	Fecal coliform
Total suspended solids (TSS)	TSS*
Oil and grease	TSS*
pH	Biochemical oxygen demand/TSS*
Metals	Dissolved Copper (Cu)
Nitrogen ammonia	Total P
Phosphorous	Total P
Pathogens	Fecal Coliform/E. Coli
Projected dissolved oxygen (concentrations)	Biochemical oxygen demand
PCBs	PCBs/TSS*
PBDEs	PCBs/TSS*
semi-volatile organic compounds	PCBs/TSS*
Pesticides	PCBs/TSS*
**Still evaluating the data available*	

June 25th Expert Panel Meeting

An update on the RCOCs was provided to the Expert Panel at the June 25th meeting. Minor changes were made (represented in Table 3 below) based upon input from the panel members and the continued review of the data sets. The main difference with the previous table presented was the recognition of looking at dissolved and total zinc and considering the impact of biochemical oxygen demand (BOD) ultimate on projected dissolved oxygen. It is difficult to characterize PBDEs, semi-volatile organic compounds, and pesticides due a large proportion of non-detects. An Expert Panel comment suggested using BOD ultimate instead of 5-day BOD (BOD_5) for considering impacts to dissolved oxygen. BOD_5 data will be converted to BOD ultimate to better assess the impacts on dissolved oxygen.

Comments on RCOCs and the Available Data from the June 25th Expert Panel Meeting:

- Jean Zodrow asked why zinc was added as a constituent of concern.
  - Beth Schmoyer of SPU said that SPU added zinc because it is a specific benchmark for industrial stormwater permits that facilities often struggle with. SPU plans to look at both copper and zinc.

- For the proposal to assess PBDEs using total suspended solids (TSS), Jean Zodrow mentioned Sandy O'Neill's study of pollutant loads and cycling through biological organisms in Puget Sound, although Ms. Zodrow wasn't sure whether the study specifically considered PBDEs.
  - Members of the technical team said that they would examine that resource.
- Bob Pitt questioned the decision to use BOD/TSS as an RCOC for pH, if pH were specifically listed in the consent decree. He said that reduced concentrations result in subtle changes in pH. Rob Annear of Geosyntec said that the team can discuss the approach to pH at a future Expert Panel meeting.
- Panel members made several suggestions related to the presentation of the data, as follows.
  - Bob Pitt suggested adding the numbers of observations to the box plot charts.
  - He also suggested presenting the data with a truncated probability distribution, or plotting the data based on percent detected.
  - Some Panel members noted that the Y axis was different in the slides, but should be consistent in future presentations.
  - Eric Strecker of Geosyntec said the team would be increasing the font size for the charts.
- Several Panel members commented on the differences between the data for different site types, and noted that land use categories such as industrial can vary significantly. There are highly site specific reasons why the data may differ, such as roof runoff and urban wildlife in forested areas. In addition, Bob Pitt noted that seasonality is important, due to inputs to the land.
- Bob Pitt and Derek Booth commented that for some pollutants, there may be a significant amount of data that are below or very close to detection levels (practical quantification levels). Furthermore, they noted that scaling data containing a large amount of non-detected values could skew the overall results. (The suggestions above for indicating the number of observations in charts and presenting data with truncated probability distributions could help address issues with non-detects.) For the PCBs, in particular, Bob Pitt said that detection limits will be critical.
- Mark Henley of Ecology asked how the technical team would compare the reductions in fecal coliform loads from stormwater projects to those that come from eliminating CSOs. He indicated that the stormwater projects would have to reduce fecal coliform levels significantly to be comparable to the benefit from reducing CSOs.
  - Bob Pitt commented that there are highly site specific reasons why some sites have high fecal coliform levels. Jonathan Frodge of SPU said that some of the numbers may be correlated with homeless encampments in the vicinity of the sites.
- Beth Schmoyer of SPU expressed concern about the technical team's proposal to use bis(2-ethylhexyl)phthalate as the RCOC for semi-volatile organic compounds (SVOCs). She noted that bis(2-ethylhexyl)phthalate is everywhere (including lab contamination) and is not very toxic to humans. Other contaminants are more differentiated. Bob Pitt suggested that including the frequency of detection as a measure would help.

- Beth Schmoyer and Rob Annear discussed the use of use bis(2-ethylhexyl)phthalate as the RCOC for SVOCs following the meeting and determined that given the available data, the use of use bis(2-ethylhexyl)phthalate as the RCOC for SVOCs would be acceptable.

Table 3: Comparison of RCOC Changes

Constituents of Concern Identified in the Consent Decree	Potential RCOCs in April 22, 2013 Briefing Memorandum	June 25th Recommended RCOCs
Biochemical oxygen demand (BOD)	BOD	BOD
Fecal coliform bacteria	Fecal coliform	Fecal coliform
Total suspended solids (TSS)	TSS	TSS
Oil and grease	TSS	Oil & Grease
pH	BOD/TSS	BOD/TSS
Metals	Total and Dissolved Copper	Total Cu, Diss Cu, Total Zn, Diss Zn
Nitrogen ammonia	Total P	Ammonia-N
Phosphorus	Total P	Total P
Pathogens	Fecal coliform	Fecal coliform
Projected dissolved oxygen (concentrations)	Biochemical oxygen demand	Biochemical oxygen demand
PCBs	PCBs/TSS	Aroclor 1254
PBDEs (Polybrominated diphenyl ethers)	PBDEs/TSS	PBDEs/TSS
Semi-volatile organic compounds	PCBs/TSS	Bis(2-ethylhexyl)phthalate
Pesticides	PCBs/TSS	Dichlobenil

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August 28th Expert Panel Webinar

There were a few changes to the list of RCOCs between the June 25th meeting and the August 28th Webinar. The changes include: pH (or [H+]) was being considered directly instead of BOD/TSS; Total PCBs were considered instead of Aroclor 1254; and Projected DO was being considered instead of using BOD ultimate.

The team did present to the Expert Panel a table that displayed the sources of the data for the RCOCs. The table is included below.

	Residential					Commercial					Industrial					Open Space					Grouped		
	ACWA	NSQD	Portland	SPU	Tacoma	ACWA	NSQD	Portland	SPU	Tacoma	ACWA	NSQD	Portland	SPU	Tacoma	ACWA	NSQD	Portland	SPU	Tacoma	King Co	Spokane	SPU
[H+]	x			x	x	x			x	x	x			x	x		x						
Ammonia-N		x		x			x		x			x		x			x						
Bis(2-ethylhexyl) phthalate				x	x				x	x				x	x								
BOD5	x			x	x	x			x	x	x			x	x	x	x						
Copper, Dissolved	x			x	x	x			x	x	x			x	x	x	x						
Copper, Total	x			x	x	x			x	x	x			x	x	x	x						
Dichlobenil				x	x				x	x				x	x								
Fecal Coliform	x			x	x	x			x	x	x			x	x	x	x						
Oil & Grease	x	x				x	x				x	x				x	x						
PBDE																					x	x	
PCB																					x		x
Total Phosphorus	x			x	x	x			x	x	x			x	x	x	x						
Total Suspended Solids	x			x	x	x			x	x	x			x	x	x	x						
Zinc, Dissolved	x			x	x	x			x	x	x			x	x	x	x						
Zinc, Total	x			x	x	x			x	x	x			x	x	x	x						
Note: Vacant and open space assumed equal to residential if no data were available.																							

There were no specific comments from the Expert Panel members during the Webinar on the RCOCs.

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In closing, the Integrated Plan team has used the Consent Decree, available data and its collective knowledge of stormwater management and best professional judgment to create the list of RCOCs. The surrogates selected represent constituents of concern that are applicable to the land use and receiving water bodies in Seattle.

The Integrated Plan team is available to discuss the RCOS if needed and can answer any questions or provide additional information (pending availability) if needed.

Cordially,

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